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Improving the resilience of agricultural systems through innovation platforms: creating space for farmer participation in research

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Abstract

Responding to global food crisis, such as imposed by climate change, requires resilient food systems that are able to respond to shocks. Resilience thinking, as an approach to agriculture development, focuses on enhancing the capacity of both the human and ecological systems inter alia. In this paper, the concept of resilience is approached from the perspective of socio-ecological systems dynamics. In particular, the study examined the contribution of farmers to research towards enhanced resilience of traditional African vegetable production systems in northern Ghana. An Innovation Platform was set up as a 'knowledge space' that provided an enabling environment for the interaction between farmers' indigenous and researchers' scientific knowledge in agricultural research. The study revealed that indigenous knowledge can be invaluable to building resilient food systems. However, ensuring that farmers participate effectively and contribute to research effort requires good community mobilization and facilitation skills by scientists as farmers need to be assured that their knowledge and other contributions are valued and their views respected by scientists. Good communication skill is necessary for effective knowledge brokering by researchers. Beyond the farmer, building a good relationship with the community is important in ensuring buy-in by farmers.

Keywords: *Resilience, Researchers, Varietal Evaluation, Knowledge, Innovation Platforms*

INTRODUCTION

Addressing global food crises calls for not only addressing short-term food needs of vulnerable people but also addressing the fundamental problems of global food and agricultural systems (Canadian Food Security Policy Group, 2008). That the resilience of the current food systems is being stretched to the limit is a fact as is amply demonstrated by the current food crisis in many regions of the world. The current food crises, however, can be attributed to a manifestation of a gradual but unrestrained interference in the natural ecosystem over the long term by human beings and the erosion of indigenous knowledge usually replaced by scientific knowledge. Intensification of agriculture, founded on increased access to fertilizers, chemicals and improved seeds has been touted as the panacea to global food insecurity led by the green revolution in Asia in the 1960s. Several years down the line, however, global food insecurity has rather worsened especially in the south. In Ghana, for instance, a fertilizer subsidy program introduced by Government to support farmers has run into serious challenges, as Government is unable to sustain it. According to the World Bank (2007) the rapid rise in the price of basic food staples has pushed as many as 105 million additional people into situations of chronic hunger, raising the total number of people who are hungry to just under one billion. Among those most vulnerable to the food crisis are rural families, who make up 75 percent of the developing world's poor and 70 percent of the world's malnourished. Of the 3 billion rural people in developing countries, 2.5 billion depend on agriculture for their livelihoods and 1.5 billion are smallholder farmers. On the backdrop of the above concerns, the current agricultural system being pursued by development agencies has been criticized as undermining the integrity of ecological systems and well-being of people that depend on them (Drèze and Sen, 1989). Therefore, ensuring resilience of food systems is critical not only for the sustenance of humanity, as the world experiences food crisis of global dimension, but also a pathway to ensuring ecological health and environmental integrity. Sustaining food systems and yet ensuring ecological health is one of the critical challenges faced by humanity in recent times (Naylor, 2008) as the world experiences climate change on unimaginable dimensions. However, to make progress in this sense requires a paradigm shift that promotes social and ecological resilience through the recognition that local food systems are context specific and that indigenous knowledge is as important as scientific prescriptions in ensuring systemic resilience.

The concept of resilience

From its roots in material science the concept of resilience has gained much ground in other disciplines. In the development context, the concept provides an interesting and insightful nexus between social and ecological dynamics in situations where issues of vulnerability are concerned. While the world is grappling with the challenges of sustaining natural ecosystems in the face of enormous natural and man-made shocks, such as climate change and natural disasters, perhaps it is much more appropriate to address these within the context of resilience. Unlike the concept of sustainability the concept of resilience allows for a much more realistic analysis of socio-ecological dynamics as it recognizes the fact that change is a normal part of socio-ecological systems but the ability of a system to evolve within critical limits is what is important.

In this paper, the concept of resilience is approached within the context of the dynamics and development of socio-ecological systems (figure 1). Folke et. al., (2010) define resilience in this context as the capacity of a social system to continually change and adapt yet remain within critical thresholds. According to the Intergovernmental Panel on Climate Change, resilience is "the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change" (IPCC, 2007).

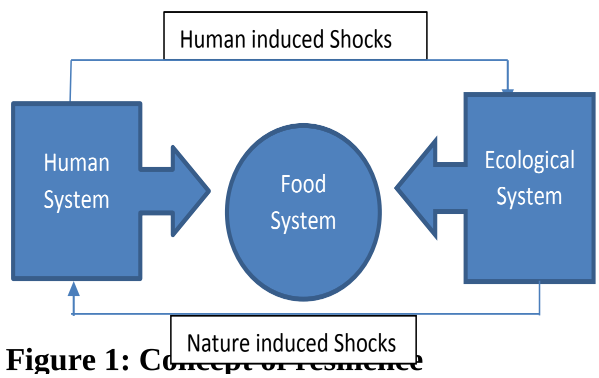

Figure 1: Concept of resilience
Adapted from Martinez et. Al., 2012

Agricultural systems survive on an intricate and delicate relationship between natural and humans systems. The continuous interaction of the two, defined by contextual factors, has found expression in various food systems all over the world. In human systems, resilience refers to the ability of communities to withstand or recover from shocks, be it natural or man-made. On the other hand, resilience in natural systems refers to how much disturbance ecological system can handle without shifting into a qualitatively different state. Thus, the nature of food systems invariably affects ecological quality just as ecological quality affects the nature of food systems. Similarly, the type and nature of human interaction with nature in the process of satisfying our food needs impacts on natural processes just as ecological quality dictates the nature of food systems. Consequently, the resilience of food systems is driven by contextual factors. Thus, it is the inherent interplay between human welfare, food production, and the state of the world's natural resources that makes the need to manage these systems for resilience critical (Naylor, 2008).

Resilience thinking as an approach to agriculture focuses on enhancing the capacity of both the human and ecological systems inter alia. This way, inherent systemic risks are reduced and the robustness of both systems to withstand shock is improved (Canadian Food Security Policy Group, 2008). This is more likely to benefit smallholder farmers than conventional approaches that largely neglect their needs (Adger, 2003). In this paper, we explore the concept of resilience on the basis two-core principles namely:

- Local knowledge improves resilience through innovation
- Building trust and mutual reliance(among scientists and local people) leads to systemic resilience

Local food systems are unique in their own right as they encompass a wide array of contextual factors that inter-play with each other to define their specific nature. On their own, local food systems have evolved over time by adapting gradually to changing local conditions. Of course, such local conditions are influenced by changes at the global level. However, it is the manner in which such changes at the global level find expression locally that determine the specific nature of their effect on local food systems. Efforts at improving food security have often by-passed these contextual, and often socio-cultural, factors in favour of top-down technology driven approaches that have not inured much to the benefit of the smallholder farmer as in the case of the 'green revolution' in India (Dreze and Sen, 1989). These high input approaches have often sought to prescribe solutions for farmers rather than support them to overcome their challenges. Consequently, top-down "technology transfers" have largely failed because they do not take into account the considerable knowledge of local farmers as well as the diversity of agro-ecosystems and the rural communities that depend on them (Canadian Food Security Policy Group, 2008). Smallholder farmers operate in complex, diverse and often risky situations with their own inherent dynamics that conventional agricultural science is unable to explain adequately (Thompson et al, 2007). As such, they are faced with a complex set of challenges that have rendered them more vulnerable.

Creating a 'knowledge space' for farmer-researcher knowledge exchange

Integrating indigenous or farmers' knowledge and scientific knowledge is critical in ensuring locally responsive development interventions. However, integration can only be effective if there is effective participation in the change process by all stakeholders including smallholder farmers (Dittoh, 2003). The diagram below is adapted from Dittoh (2003). It describes the process for effective participation and integration of indigenous and scientific knowledge for effecting resilient change processes. The principle is based on the fact that indigenous knowledge forms an integral part of socio-cultural systems. As such, they are context specific. Therefore, development intervention can only build upon indigenous knowledge in order to succeed and not replace them. Consequently, development, in this context, is viewed as a continuous interaction between existing and new knowledge built upon effective interaction among stakeholders. Such an amalgam of ideas eventually, results in more resilient social and ecological systems. Instead of the typical top-down injection of scientific knowledge scientists are regarded as 'bettering' agents rather than change agents whose contributions serve to enhance the existing system.

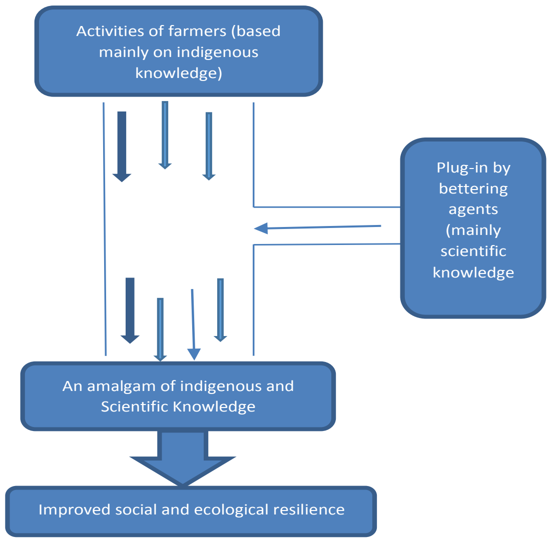

Figure 2: The Plug-in principle integrating farmer-scientist knowledge
Source: Dittoh, 2003

The Role of Innovation Platforms (IP) in knowledge exchange among farmers

Researchers have usually adopted multi-stakeholder platforms as a means to ensuring participation of farmers in scientific research. In most cases, participation is quantified in the number of farmers participating in such platforms while in actual fact most of these farmers remain passive participants in research process. In this study, we explored the use of Innovation Platform (IP) as a means to facilitating farmer-researcher knowledge exchange. The idea is not to simply integrate farmer knowledge in scientific research but to create the right conditions to enable farmers participate in research as active participants rather passive participants. An IP is a group of individuals (who often represent organizations) with different backgrounds and interests. They may design and implement activities as a group or coordinate activities by individual members (Innovation Platforms Practice Brief 1, 2013). IPs thus, provide the avenue for effective interaction of stakeholders. The members come together to develop a common vision and find ways to achieve their goals. The IP served as an avenue to generate ideas and to share knowledge in a participatory manner through action research. Thus, a key question that needed to be answered was: how can the project implement an IP that will ensure a good amalgamation of both indigenous and scientific knowledge and from the perspectives of different actors while ensuring that farmers take the lead in determining priorities? The case must be made that an IP is typically a 'space' for generating knowledge and ideas with the aim of improving the current situation. The purpose, in our case, was to re-enforce effective communication within the actor constellation and to create synergy towards achieving a common objective namely: to increase the options available to vegetable farmers regarding the type of varieties they are currently cultivating by introducing improved varieties of vegetables to them. Viewed this way, an IP creates an opportunity for actors to contribute ideas in a free and unconstrained manner. As described above, the starting point is farmers' (indigenous) knowledge while scientific knowledge is regarded as contributing to bettering or improving upon what exists. Our experience has shown that once farmers are made to understand this adequately they feel more confident and are able to contribute to discussions.

Project Background

In 2013, AVRDC-The world Vegetable Center and its partners in Ghana, Burkina Faso and Cameroun commenced the implementation of a 3-year multi-country project namely; 'Enhancing Productivity, Competitiveness and Marketing of Traditional African (Leafy) Vegetables (TAVs) for Improved Income and Nutrition in West and Central Africa'. The purpose of the project was to increase production and consumption of TAVs by overcoming constraints such as low productivity of current cultivars and landraces, lack of good quality seeds, limited knowledge of post-harvest and processing options and opportunities and a lack of awareness of nutritional benefits. According to Abukutsa-Onyango (2010), TAVs are the most affordable and sustainable dietary sources of vitamins, trace elements and other bioactive compounds for the poor as they are a major source of most micronutrients and offer the only practical and sustainable way to ensure that micronutrients are supplied through the diet among the rural poor. Various TAVs have high nutrient content and are culturally accepted, usually eaten with cassava and maize staples. However, TAVs have received little attention from researchers. Hence their contribution to local diets and economies is poorly understood or quantified, despite their potential (Pasquini and Young, 2007). Increasing production and consumption of such vegetables is constrained by the low productivity of current cultivars and landraces; lack of good quality seeds; limited knowledge of post-harvest and processing technologies and opportunities, poorly developed value chains and a lack of awareness and nutritional benefits of fresh and processed products. Thus, the project sought to identify and promote the most productive and nutritious cultivars of the selected vegetables, and simultaneously to boost their profitability and consumption for food and nutritional security. A major component of the project was the evaluation of promising/advanced lines of TAVs present in AVRDC's germplasm collection for high yield, resilience to biotic and abiotic stresses, high nutrient content and market potential using farmers' or growers' participatory approach. The crop varieties include: Amaranth, Chochorus, Okra, Roselle, Eggplant and African Nightshade.

The project context

The project was implemented in a total of five best practice hubs (BPH) and twelve communities in the Northern and Upper West regions, which constitute part of Northern Ghana. The area falls within the dry land Savannah zone occupying an estimated 40% of the country. The rainfall pattern is mono-modal permitting a growing season of about 180–200 days in these two regions. Mean total annual rainfall varies from 1,000 mm to 1,200. The rainfall shows wide variations from year to year, both as regards the amount and the time when it occurs, and the dry season is so intense that unless it has been preceded by a good harvest acute food shortages often result. Cultivation of TAVs takes place year round.

Table 1: Location of Best Practice Hubs

Region	BPH	Communities
Northern	Libga Hub	Libga, Zaazi, Bihinayili, Nyoglu,
	Sahakpalgu Hub	Sahakpalgu, Sahanaayili, Gumbihini
	Dufa Hub	Dufa, Duuyin Kparishea
Upper West	Busa Hub	Busa
	Kane	Kane

Methods of Data Collection and Analysis

Data was collected and analysed by way of participatory appraisal methods. Records were taken of each activity of each IP meeting. These were shared with IP members who analysed the results against the objectives of the IP during monthly IP meetings. For the purpose of this study these results were further analysed by researchers at the end of the intervention and consolidated into experiences of the IP. This was complemented by further data collected and analysed by way of focus group discussion in each beneficiary community.

Setting the IP Strategy and Objectives

Each community within a Best Practice Hub (BPH) was sensitized extensively on the objectives of the project and opinions solicited from community members regarding the best way possible to incorporate farmers' views and knowledge. It was agreed that the IP should function at the level of the BPH. After the initial sensitization, each community within a cluster agreed to select two farmers each to represent them on the IP. It was jointly agreed with researchers regarding which other partners and institutions needed to be included in the IP. Thus, participation in the IP was occasioned by clearly defined criteria jointly agree by stakeholders.

Participating communities were selected based on the following criteria:

Selection Criteria	Detail
TAV potential	Level of TAV sector development and/or potential for increasing awareness creation and investment in the agro-ecological zone/communities.
Research requirements	Water availability and quality (observable), agro-climatic zone suitability, water access, irrigation systems, market access by producers and other value chain actors, information and support systems.
Crop Variety	Agronomic features (e.g., yield levels, growth cycle etc.), economic value of TAV, nutritional value of TAV
Community Level	Degree of importance of TAVs in food habits and consumption patterns, levels of malnutrition in the proposed communities, especially among women, youth and children.
Institutional Support	Level of access to institutions that support TAV sector development
Enabling Policies	Enabling national and regional government policies and institutional frame work supporting production, marketing and consumption of TAVs. e.g., farmer-led seed production systems, price, market, tax policies and post-harvest handling.
Impact Potential	Possibility of scaling-up and rolling out, and rapid impact of proposed TAV interventions. e.g., population density thresholds of existing producers and consumers and/or potential producers/consumers including institutional producers (and consumers) such as school gardens and school feeding programmes.

Table 2: Key actors within the 'Knowledge space'

Actor	Potential contribution
Farmers	• Target beneficiaries • Custodians of traditional knowledge
Scientists	• Custodians of scientific knowledge • Project facilitation
Ministry of Agriculture	• Technical knowledge • Understanding of prevailing conditions for vegetable production
Irrigation Development Authority	• Knowledge and expertise in water management
Traders	• A good understanding of the local vegetable market
NGOs	• Community mobilization • Extension support for farmers
Traditional Authority	• Custodians of land • Custodians of traditional knowledge • Community mobilization

At the initial meeting of the IP, the following objectives were agreed as needing immediate attention.

- to agree on which of the introduced varieties were suitable for cultivation
- to determine the key constraints along the TAV value chain

Following this, monthly meetings were held to discuss the extent of achievements of the objectives and related matters.

Action Research

A main demonstration field was established on the Nyankpala campus of the University for Development Studies (UDS) where all vegetable varieties were planted while farmer-led demonstration fields were established in all participating communities. These included 10 varieties of Okra, 6 varieties of roselle, 3 varieties of jute mallow and 5 varieties of amaranth. Farmer-led varietal evaluation were conducted on the main demonstration field. These included 10 farmers from each community with a total of 120 farmers participating from the Northern and Upper West Regions. Traders also participated in selecting their preferred choice of crop varieties. Prior to the varietal evaluation on the main demonstration field each community conducted similar varietal evaluations in the various clusters where farmer-led demonstration fields were established. A total of 200 farmers were involved in all. The varietal evaluation also included farmers from additional communities that were not originally, beneficiaries of the project but opted to participate after observing farmer led demonstration fields. These are Golinga in the Tolon District of the Northern Region and Nadowli and Dafiama in the Upper West Region. The purpose of the varietal evaluation was for farmers to select their preferred vegetable varieties based on clearly defined criteria by each participating community.

The Evaluation Process

Several field visits were conducted for farmers to acquaint themselves with the different vegetable varieties from planting through to harvesting. Each group of farmers discussed and shared their experiences in each instance. Selected farmers from each participating community agreed on common criteria for selecting their preferred varieties. This notwithstanding, efforts were made to ensure that individual differences were not suppressed. Therefore, farmers were allowed to tag the different varieties of the various vegetables according to their individual discretion with the criteria agreed by the groups serving only as a guide. Farmers were allowed to complete the entire process of evaluation with no interference, whatsoever, from researchers. Researchers then took count of the total number of farmers selecting the various varieties while farmers explained the reasons informing their preference. The table below presents the results of the evaluation.

Plate 1. A woman tagging her preferred variety of okra

Plate 2. A group of farmers discussing a new variety of Roselle

RESULTS

Consultation is key to successful collaboration with farmers

Farmers were enthused about the broad consultation processes that preceded the establishment of the innovation platform, during the process of implementation and the varietal evaluation. The consultative process ensured that farmers' views were adequately taken on board the conception and the implementation of activities under the innovation platform. An important lesson here is the fact farmers must be provided adequate opportunity to contribute to research not only as 'late comers' to the process, often after research projects have been conceived by scientists, but as co-initiators of research. It also builds farmer confidence as valuable contributors to the research process. This is important in building confidence among farmers towards effective participation in research.

Farmers' efforts in research must be rewarded

Farmers stressed the need to be compensated for time spend in participating in research. Farmers measure their input in research against the expected results and the need to balance their short term needs against long term benefits from research. Therefore, in requesting farmers to contribute to research effort it is crucial to ensure a clear understanding of the potential benefits in order to ensure adequate commitment from farmers. There is the need sometimes to balance short term gains with longer term gains in designing research in order to ensure commitment from farmers. In the case of the current intervention farmers had immediate access to improved variety of vegetables while participating in the research paid off against longer term goals like promoting consumption of TAVs among rural households.

What informs farmer preference for particular varieties?

It is obvious from the farmers' selection criteria for the various vegetable varieties, as shown in table 3 below, that the over-arching consideration for the selection is economic demonstrated by the need to meet market requirements. These include productivity (Fruit/leaf size, rate of fruiting/leaf production), attractiveness, taste, delayed flowering (leafy vegetables). This is not surprising as vegetable production, especially during the dry season, has become a major economic activity for most communities where there is access to water year round.

What role for scientists?

Conducting action research in the context of innovation platform was challenging but rewarding in terms of research uptake. Balancing farmer objectives and scientist's objectives, as dictated by project requirements was particularly challenging necessitating the need for scientists to compromise on some of project objectives. In particular, while scientists considered improved water management as key to sustaining vegetable production in northern Ghana farmers were not keen on that aspect of the project preferring to focus on access to improved varieties of vegetables dictated by the need for short term economic benefit. Thus, after the first year of project implementation the focus of action research shifted to promoting farmers' preferred varieties and improving farmer knowledge on seed production and storage. Farmers were subsequently trained on seed production techniques and further research initiated on improving locally available and cost effective methods of preserving seeds. Thus, the role of scientists in this context was that of facilitators rather than drivers of the research agenda. This requires careful management of relationships in driving the collective research agenda. During the process it became obvious that scientists required essential participatory skills in managing scientist-farmer relationship and a good understanding of socio-cultural factors underpinning such relationships.

Some of the 'new' and 'improved' vegetable varieties were not new

It was revealing, especially for scientist, to know that some of the 'new' varieties were known to farmers as they have been cultivated in the past. This generated an interesting discussion about the reasons why such vegetable varieties are no longer available. Two main issues stood out as explanations. These are poor storage and economic factors. Over the years farmers have adopted various indigenous methods of storing seed which is retained from previous harvests. Thus, seed viability has posed a major challenge to sustaining TAV seeds over the years. Some of the seed, although well adapted to the local environment, are low in productivity. Consequently, increasing commercialization has resulted in the gradual erosion of such varieties over the years due to the need to increasingly meet farmer cash needs. To some extent, consumer preference has dictated to survival of some of these varieties. This was the case of some okra and jute mallow varieties. For instance, Sarok 2 and ML-OK 10 were identified by farmers as particularly difficult to store as they easily lose viability.

DISCUSSION

Ensuring that farmers participate effectively in a research setting requires good community mobilization and facilitation skills by scientists. Farmers need to be assured that their knowledge and other contributions are valued and their views respected by scientists. Good communication skills are necessary for effective knowledge brokering among the various stakeholders. When collecting scientific data it is important that farmers participate and scientists make farmers understand why they collect such data. When this is done farmers feel a sense of ownership and are ready to contribute whatever way they can to success of the project. This, it must be noted, requires a great deal of patience some of the time. However, the benefits are great. In the case of this project, some farmers offered to be trained to help scientist collect data. In some other cases, farmers simply wanted to be informed when scientists are on the field to collect data even if they had no role to play. They felt included by simply observing the scientist work. Thus, working with NGOs proved very useful as they had good facilitation skills and understood the local dynamics very well. It is important that scientists acquire community mobilization and facilitation skills in order to ensure that they acquire the necessary input from farmers.

It is obvious that researchers, by their training, are not in a position to manage such complex and demanding relationships as is required in collaborating with local communities and only want to get on with their work. In our view, it is not adequate to include a social scientist in research teams. Researchers must be given training on basic community relationship management. Relationships are context specific and culturally sensitive. Therefore, scientist, irrespective of their disciplines, must be in a position to analyse and understand the societal and cultural dynamics in the areas in which they work. In one instance in our case, farmers felt offended by researchers because they harvested crops, in the course of data collection, and left them on the field without inviting farmers to collect them resulting in a waste of food while they have need for it. Until researchers are able to understand the social and cultural dynamics of local communities and interact with farmers in acceptable ways participation by farmers in research projects will be an illusion.

Table 3: Farmer selection criteria

Crop	**Variety**	**No. of farmers**	**Reasons for selection**
Okra	NOKH 1002	5	Early maturing, more axillary shoots

	MAHFI	13	Large fruits, early fruiting, attractive, high demand, bears many fruits, slimier for food preparation.
	NYAKPALA LOCAL	13	Unattractive fruits, low market demand but early maturing than other varieties
	SASILON	22	Early maturing, fruit looks long and big, bears many fruits, attractive colour.
	NOKH 1004	13	More fruits, less leaves, high yielding, easier to preserve
	P1496946	26	Leaves are sweet, looks greener, and broader, high demand.
	AAK	0	Matures too early, tiny fruits, fruits shrink easily making preservation difficult, low market value, not having enough leaves
	SAROK 2	1	Seed easily loses viability, reddish colour makes it attractive
	ML-OK- 10	0	Seed easily loses viability, cannot be relied on
	NOKH 1003	0	Fruits are small, shrink easily making preservation difficult, delayed maturity, tip of fruits bends and does not grow fast
Roselle	SAMADA	10	Medicinal value (controls blood pressure), broad leaves, more shoots, height is okay, used for porridge prepared, leaves can be used for ground nut soup.
	MORONGO	0	Rough leaf structure, unattractive, as compared to the others, more like the local varieties
	DAH ROUGH	22	Large leaves makes crop highly productive, attractive and easier to preserve
	NAVORONGO	9	Well adapted to the local environment, late flowering hence produce more leaves, high market demand.
	LOCAL 1	4	Smooth leaves, small leaves, produces relatively more branches but flowers early
	BAFI	9	Produces relatively more leaves, attractive for market
Jute Mallow	AZIGA	13	Attractive, highly productive
	UG	13	High demand
	IP2	1	Not attractive physically
Amaranth	AC- NL	8	Highly productive and high demand
	MADIIRA 1	0	Leaves are unattractive, low market value, small leaves as compared to the others.
	AH- TL	0	Flower too early
	EX ZAH	5	Attractive leaves, less insect attack
	MADIIRA 2	24	Highly productive, late flowering, large leaves, tasty, gives garden a pleasant look, high demand

Farmers can be independent and take important decisions regarding their livelihoods if given adequate support and encouragement. For example, based on the results from the individual farmer-managed demonstration fields in the communities some farmers took the decision to multiply seed all by themselves. In some communities, female farmers opted to have demonstration fields separate from those of the males in order to demonstrate their competence.

Towards resilience of TAV production in northern Ghana

Resilience, in the context of this study, is founded on a mutually beneficial interaction between human and ecological systems in the context of agro-ecological system, in this case, illustrated in the production and consumption of traditional African vegetables in the specific context of northern Ghana. Within the context of Innovation Platforms the study explored what the authors consider a critical factor in ensuring resilience in agro-ecological systems namely; effective participation of farmers in 'scientific' research. A major constraining factor that militates against the successful production and commercialization of TAVs in Northern Ghana is lack of knowledge and skill to preserve seed of traditional vegetables resulting in the extinction and near extinction of some of such varieties.

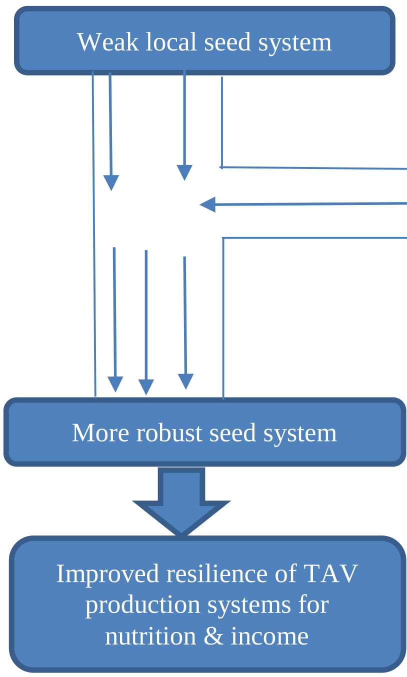

Figure 3: Towards improved resilience of TAV seed system
Source: Author's construction

Over the years indigenous (farmers') knowledge has alone has proven inadequate in supporting the local TAV seed system due to changing social and ecological conditions such as introduction of more exotic or less familiar varieties of TAV, low soil fertility and consumer preference. This has resulted in a weak TAV seed system supported on the basis of a weakening local knowledge base. This underscored the need for scientific knowledge in addressing the inherent weaknesses in the TAV seed system. Scientific knowledge, in this regards, is not an option for replacing indigenous knowledge but a resource to boost indigenous knowledge towards a more resilient local TAV seed system. The following actions have been deemed necessary in achieving this:

Training of local vegetable farmers as seed growers

A training of trainers' course on seed production has been successfully completed for farmers and selected stakeholders. Participants were educated on the technical requirements of seed production, as well as, certification processes. Following this, some farmers have successfully multiplied seed of selected vegetables.

Research on preservation seed preservation

Research is ongoing on improving locally available seed storage techniques. The rational of this intervention is to identify and promote locally accessible simple and affordable seed preservation methods among farmers. Preliminary analysis of the results show that about 80% of farmers encounter pests and diseases of seed during storage.

Further varietal trials

Following farmers' evaluation of the various vegetable varieties further varietal trials are ongoing, both on-station and on-farm, of the 3 highest ranked vegetable varieties in a collaborative effort between the University for Development Studies and the Savannah Agricultural Research Institute. This is to further characterize them in relation to the specific context of northern Ghana.

Lesson learned

Ensuring effective participation by farmers in research projects requires that farmers give off their optimum. This, in turn, requires much more effort by researchers as it involves managing complex relationships which is tedious, time consuming and requires special skills to handle. Thus a critical requirement for this is a basic understanding of local social and cultural dynamics by all researchers irrespective of their disciplines. It goes beyond merely including socio-economists in research teams as optimizing farmer participation in research projects requires a team effort and not the sole domain for a socio-economist. Experience from this research indicates that research scientists are, generally, ill-positioned for such a task as their training does not offer them the necessary skills required for managing community relationships. Farmers have gained a great deal of knowledge and experience over the years by interacting with researchers and other stakeholders sometimes much more so than researchers. However, most farmers do not realize the value of their own knowledge and experience and think the scientific knowledge is always superior.

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